process and decoding processes. In the encoding process, the original image is divided into a plurality of blocks for compressing the information of a spacious region, and a two-dimensional DCT is performed with respect to each block, and a redundancy is decreased in the image or between the images using a correlation on a time axis between the images for decreasing the information of the time region. In addition, in the decoding process, the reverse sequence of the decoding process is performed. In order to implement the MCDCT technique, an encoder and decoder are required.

Figure 1 is a block diagram illustrating a conventional image encoder. As shown therein, an input video signal is subtracted by a subtractor 1 with a motion compensated video signal from a video memory 9 and is inputted via a first switching unit 2 and a DCT unit 3. The DCT unit 3 processes the inputted video signal based on a DCT, and a quantization unit 4 quantizes a DCT-processed video signal and outputs a DCT coefficient q. This coefficient is reversely quantized by a reverse quantizing unit 6 and is processed based on a reverse DCT by a reverse DCT unit 7 for thereby recovering the original video signal. The thusly recovered video signal is summed by a summing unit 8 with a video signal recovered in the earlier process via a second switching unit 10 and is inputted into the video memory. A controller 5 controls the first and second switching units 2 and 10 and transmits an intra/inter information (p=mtype; flag for INTRA/INTER), a transmission information (q; flag for transmitted or not), and an quantizing information (qz=Qp; quantizer

A1 con't

indication) to a decoder (not shown in Figure 1). The video memory 9 outputs a motion vector information (v=MV; motion vector) to the decoder. The DCT unit 3 outputs a DCT coefficient q to the decoder.--

Page 3, line 8, through page 4, line 1, has been replaced as follows:

A2

--Namely, in the case of the coding technique using a DCT in a system which is capable of coding a still picture or a motion picture, the entire image is divided into a plurality of small images (for example, 8x8 blocks), and then a transforming operation is performed with respect to the divided blocks, and the original image is processed based on a DCT, and an important information of the original image based on a result of the conversion is included in the low frequency component. As the component becomes high frequency, the important information is decreased. The low frequency component includes an information related to the neighboring block. The DCT transform is performed without considering a corelation between the blocks. Namely, the low frequency components are quantized by the blocks, so that a continuity between the neighboring blocks is lost. This phenomenon is called as the blocking artifacts.--

On page 4, lines 13-17 have been replaced as follows:

A3

--The low pass filter sets a filter tap or a filter coefficient based on or by selecting (filter mask) a plurality of pixels near a certain pixel and obtaining an

44

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A3 con't

average of the pixels. The recovered images are over smoothed in accordance with the kinds of images, and a compression ratio.--

On page 6, lines 5-~~15~~ 14 have been replaced as follows:

A4

--To achieve the above objects, there is provided a method for recovering a compressed motion picture according to an embodiment of the invention, comprising the steps of defining a cost function having a smoothing degree of an image and a reliability with respect to an original image in consideration of the directional characteristics of the pixels which will be recovered and a plurality of pixels near the recovering pixels, obtaining a regularization parameter variable having a weight value of a reliability with respect to an original image based on the cost function, and approximating the regularization parameter variable using the compressed pixel and obtaining a recovering pixel.

These and other objects of the present application will become more readily apparent from the detailed description given hereinafter. however, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.--

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On page 6, after the heading "BRIEF DESCRIPTION OF THE DRAWINGS", insert the following paragraph:

A6

--The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus as not limitative of the present invention and wherein:--

17-18

On page 6, lines ~~18-19~~ have been replaced as follows:

A6

--Figure 2 is a block diagram illustrating an apparatus for recovering a compressed motion picture according to an embodiment of the present invention;--

On page 7, lines 7-18 have been replaced as follows:

A7

--Figure 2 is a block diagram illustrating an apparatus for recovering a compressed motion picture according to an embodiment of the present invention. As shown therein, a decoder 201 receives an intra/inter information (p=mtype), a transmission information (t), a quantizing information (qz=Qp), a DCT coefficient q, and a motion vector information (v=MV; motion vector) from an encoder as shown in Figure 1 and decodes the thusly received information. The encoder and decoder 201 are connected by a communication channel or network. A block removing filter 202 receives a video signal (Y,U,V), a quantizing variable (qz=Qp), a macro block type (mtype), and a motion vector

46 A

A7 con't

(v=MV) from the decoder 201 and performs an image compressing process according to the present invention for thereby outputting a recovered video signal.--

On page 8, lines 9-16 have been replaced as follows:

A8

--In the first embodiment of the present invention, a cost function having a directional feature by the unit of pixels is defined, and a regularization parameter is obtained based on the cost function. A recoverable pixel is obtained using a value which is actually adapted to the regularization parameter and is processed based on a DCT and a projection. Then a resultant data is processed based on a reverse DCT for thereby recovering an image similar to the original image. The above-described operation will be explained in detail.--

On page 15, lines 5-9 have been replaced as follows:

A9

--Therefore, the pixels included in the inter macro block are obtained based on Equation 8, and the pixels included in the intra macro block are obtained based on Equation 9. Whether the pixels of the macro block are coded in the intra macro type or in the inter macro type are determined by the intra inter information (p=mtype).--

Page 15, line 14, through page 16, line 8, have been replaced as follows:

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--As seen in Equation 5, each regularization parameter variable includes an original pixel, a neighboring pixel, and a recovering pixel (compressed pixel). In addition, since the original pixel f(i,j) and four neighboring pixels f(i,j-1), f(i,j+1), f(i-1,j), f(i+1,j) are the original pixels, these values do not exist in the decoder. Therefore, the pixels f(i,j), f(i,j-1), f(i,j+1), f(i-1,j), f(i+1,j) may not be used for an actual computation. Therefore, in order to actually use the pixels f(i,j), f(i,j-1), f(i,j+1), f(i-1,j), f(i+1,j), the compressed pixels g(i,j), g(i,j-1), g(i,j+1), g(i-1,j), g(i+1,j) must be approximated. To implement the above-described approximation, the following three cases are assumed.

A10

First, the quantizing maximum difference of the macro block unit is a ~~quantizing variable (Qp),--~~

Page 16, line 11, through page 16, line 10, has been replaced as follows:

--Third, the non-uniform values between two pixels of the original image are statistically similar to the non-uniform values between two pixels of the compressed image.

A11

As seen in the following Equation 10, each regularization variable is approximated based on the above-described three cases.

$$a_{HL} = \frac{[f(i,j)-f(i,j-1)]^2}{[g(i,j)-f(i,j)]^2} \approx \frac{[g(i,j)-g(i,j-1)]^2}{Q_{pl}^2}$$

48

A

$$a_{HR} = \frac{[f(i,j)-f(i,j+1)]^2}{[g(i,j)-f(i,j)]^2} \approx \frac{[g(i,j)-g(i,j+1)]^2}{Q_{pl}^2}$$

$$a_{VT} = \frac{[f(i,j)-f(i-1,j)]^2}{[g(i,j)-f(i,j)]^2} \approx \frac{[g(i,j)-g(i-1,j)]^2}{Q_{pl}^2} \quad \text{--(10)}$$

$$a_{VD} = \frac{[f(i,j)-f(i+1,j)]^2}{[g(i,j)-f(i,j)]^2} \approx \frac{[g(i,j)-g(i+1,j)]^2}{Q_{pl}^2}$$

$$a_{T} = \frac{[f(i,j)-f_{MC}(i,j)]^2}{[g(i,j)-f(i,j)]^2} \approx \frac{[g(i,j)-f_{MC}(i,j)]^2}{Q_{pl}^2}$$

where l represents the l-th macro block, and Qpl represents a quantizing variable of the l-th macro block. As seen in Equation 10, the difference between the original pixel which is the denominator component of each regularization parameter variable and the compressed pixel is approximated based on the quantizing maximum difference, and the difference between the original pixel which is the numerator component and the compressed pixel is approximated based on the difference with respect to the difference value between the compressed pixel and the neighboring pixel.--

A11 con't

Page 17, line 15, through page 18, line 12, has been replaced as follows:

--As shown therein, in Step ST1, whether the processing pixels are referred to the pixels of the intra macro block or the pixels of the inter macro block is judged. As a result of the judgement, in Steps ST2 and ST3, the regularization parameter variable is obtained. Namely, if the processing pixels

A12

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are referred to the pixels of the intra macro block, in Step ST2, the regularization parameter variables α_{HL} , α_{HR} , α_{VT} , α_{VDar} are obtained based on Equation 9. In addition, if the processing pixels are referred to the pixels of the inter macro block, the regularization parameter variables α_{HL} , α_{HR} , α_{VT} , α_{VD} , α_T are obtained in Step ST3. In addition, the pixel f(i,j) is obtained in Step ST4 based on the obtained regularization parameter variable. At this time, if the processing pixels are referred to the pixels of the inter macro block, and the pixels are obtained based on Equation 8, and if the processing pixels are referred to the pixels of the inter macro block, the pixels are obtained based on Equation 9.--

A12 con't

On page 18, lines 14-16 has been amended as follows:

--In Step ST5, a DCT is performed with respect to the pixel f(i,j), and then a quantizing process is performed therefor. Here, the DCT coefficient of the pixel f(i,j) may be expressed as F(u,v).--

A13

On page 23, lines 7-18 have been replaced as follows:

--Next, the cost functions including a smoothing degree and reliability are defined. The regularization parameter variable is included in only the portion (the second term of the right side in Equation 4) of the reliability with respect to the original pixel and recovered pixel. Differently from this construction, in another embodiment of the present invention, the

A14

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A14 con'd

regularization parameter variable is included in the portion which represents a reliability of the original pixel and recovered pixel as well as is included in the portion which represents the smoothing degree with respect to the original pixel and the neighboring pixel. In addition, the smoothing degree and the reliability of the pixel are opposite each other inn their meaning. Each cost function may be expressed based on Equation 19.--

On page 28, the formula at line 2 has been replaced as follows:

A15

$$
\begin{aligned}
-- \quad \frac{1-\alpha_L}{\alpha_L} &= \frac{[f(i,j)-f(i,j-1)]^2}{[f(i,j)-g(i,j)]^2} \approx \frac{[g(i,j)-g(i,j-1)]^2}{\Phi(Q_p)} \\
\frac{1-\alpha_R}{\alpha_R} &= \frac{[f(i,j)-f(i,j+1)]^2}{[f(i,j)-g(i,j)]^2} \approx \frac{[g(i,j)-g(i,j+1)]^2}{\Phi(Q_p)} \\
\frac{1-\alpha_U}{\alpha_U} &= \frac{[f(i,j)-f(i-1,j)]^2}{[f(i,j)-g(i,j)]^2} \approx \frac{[g(i,j)-g(i-1,j)]^2}{\Phi(Q_p)} \qquad \text{---(25)} \\
\frac{1-\alpha_D}{\alpha_D} &= \frac{[f(i,j)-f(i+1,j)]^2}{[f(i,j)-g(i,j)]^2} \approx \frac{[g(i,j)-g(i+1,j)]^2}{\Phi(Q_p)} \quad --
\end{aligned}
$$

On page 30, lines 2-9 have been replaced as follows:

A16

--In Step ST10, it is judged whether the pixels of the current macro block are the same as the pixels of the previously transmitted macro block based on the COD value. If they are same, in Step ST11, the recovering pixel values are substituted for the pixel values which are previously recovered based on

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A16 con't

Equation 23. If they are not same, in Step ST12, the regularization parameter variables α_L, α_R, α_U , α_D are obtained based on Equation 26, and the recovering ~~pixel f(i,j) is obtained based on Equation 22 in Step ST13.--~~

~~On page 30, after line 18, the following paragraph was added:~~

A17

--The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within ~~the scope of the following claims.--~~

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